Augmented reality pr sentation apparatus and method, and storage medium

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Abstract

A game state manager (201) manages the state of an AR game (information that pertains to rendering of each virtual object (102), the score of a player (101), the AR game round count, and the like). An objective viewpoint video generator (202) generates a video of each virtual object (102) viewed from a camera (103). An objective viewpoint video composition unit (203) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to a display (106). A subjective viewpoint video generator (212) generates a video of the virtual object (102) viewed from an HMD (107). A subjective viewpoint video composition unit (213) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to the HMD (107).

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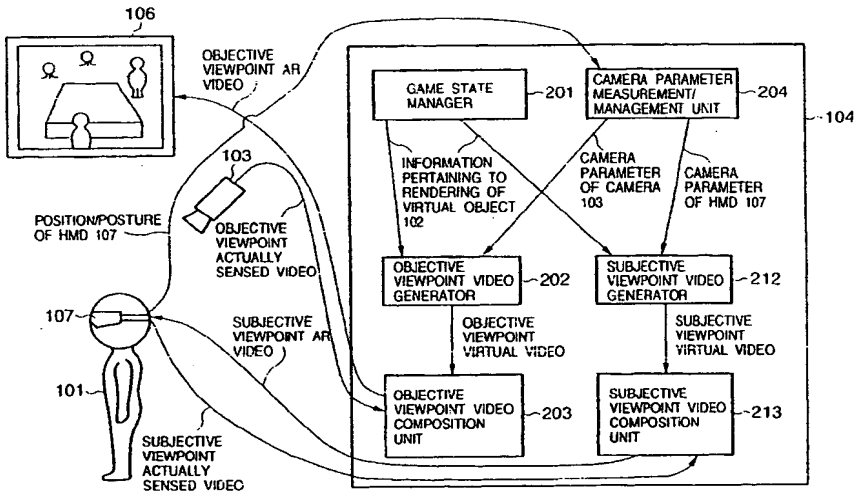
(54) Augmented reality presentation apparatus and method, and storage medium

(57) A game state manager (201) manages the state of an AR game (information that pertains to rendering of each virtual object (102), the score of a player (101), the AR game round count, and the like). An objective viewpoint video generator (202) generates a video of each virtual object (102) viewed from a camera (103). An objective viewpoint video composition unit (203) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to a display (106). A subjective viewpoint video generator (212) generates a video of the virtual object (102) viewed from an HMD (107). A subjective viewpoint video composition unit (213) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to the HMD (107).

FIG. 2



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eos of the real space and the virtual object viewed from said player's viewpoint position;
and
the display means for displaying to the player the augmented reality video viewed from said player's viewpoint position.

[0015] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 3.

[0016] That is, said augmented reality presentation means further comprises:

the second video generation means for generating a video of the virtual object viewed from said player's viewpoint position;
and
the display means for displaying to the player the video of the virtual object viewed from said player's viewpoint position on a display surface through which the player can visually see the real space.

[0017] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 4.

[0018] That is, information generation means for generating information that pertains to rendering of the virtual object, and

in that said first video generation means and said second video generation means generate videos of the virtual object using the information that pertains to rendering of the virtual object.

[0019] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 5.

[0020] That is, said information generation means generates information of an outer appearance of the virtual object and information of a position/posture of the virtual object as the information that pertains to rendering of the virtual object.

[0021] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 6.

[0022] That is, parameters of said first video sensing means are known, and

said first video generation means generates the video of the virtual object viewed from said first viewpoint position in accordance with the known parameters.

[0023] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 7.

[0024] That is, some of parameters of said first video sensing means are variable,

said apparatus further comprises measurement means for measuring changes of the parameters, and
said first video generation means generates the video of the virtual object viewed from said first viewpoint position in accordance with the parameters measured by said measurement means.

[0025] When the parameters of the objective viewpoint video sensing means, the objective viewpoint video generation means receives parameters from the measurement means, and generates an objective viewpoint video according to the received parameters.

[0026] The augmented reality presentation apparatus as a preferred embodiment of the present invention further comprises the following feature described in claim 8.

[0027] That is, the parameters of said first video sensing means measured by said measurement means include at least one of a viewpoint position/posture, and zoom ratio.

[0028] The objective viewpoint video of a virtual object is generated in accordance with camera parameters (external parameters (viewpoint position/posture) and internal parameters (zoom ratio, aspect ratio, optical axis central position, distortion ratio)) of the objective viewpoint video sensing means. The camera parameters measured by the measurement means preferably include all parameters to be changed dynamically of those parameters.

[0029] Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

Fig. 1 is a view showing the first embodiment;
Fig. 2 is a block diagram showing the flow of processes of the first embodiment;
Fig. 3 is a diagram showing the generation process of a coordinate conversion matrix used to convert the object coordinate position of a virtual object into an image coordinate position viewed from a given viewpoint;
Fig. 4 is a block diagram showing the flow of processes of the third embodiment;
Fig. 5 is a view showing a video presented to a player in the first to fourth embodiments;
Fig. 6 is a view showing a video presented to a player in the fifth embodiment;

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AR game (information that pertains to rendering of the virtual objects 102, the score of the player 101, AR game round count, and the like). Note that the information that pertains to rendering of the virtual objects 102 includes information of the outer appearance of each virtual object 102, and information of the position/posture of each virtual object 102 in the world coordinate system.

[0043] The information of the outer appearance of each virtual object 102 is information that pertains to polygons which build the virtual object 102, i.e., the number of polygons, the coordinate values of polygons, the colors of polygons, and the like. When each virtual object 102 has undergone texture mapping, the information of the outer appearance of each virtual object 102 includes a texture size, texture file name, and the like.

[0044] Reference numeral 204 denotes a camera parameter measurement/management unit which measures/manages camera parameters as parameters of the HMD 107 and camera 103. The camera parameters to be managed by the camera parameter measurement/management unit 204 includes viewpoint position/posture information as external parameters, and information of the field angle, focal length, distortion, and the like as internal parameters. The camera parameter measurement/management unit 204 stores the internal parameters of the HMD 107 as known information. At the same time, the unit 204 measures the external parameters (information of the viewpoint position and posture) of the HMD 107, and manages the camera parameters of the HMD 107. Furthermore, the camera parameter measurement/management unit 204 manages camera parameters of the camera 103 as known information.

[0045] Reference numeral 202 denotes an objective viewpoint video generator built in the AR game apparatus 104. The objective viewpoint video generator 202 generates objective viewpoint virtual videos on the basis of the information that pertains to rendering of the virtual objects 102, which is input from the game state manager 201.

[0046] Reference numeral 203 denotes an objective viewpoint video composition unit built in the AR game apparatus 104, which generates an objective viewpoint AR video by compositing objective viewpoint virtual videos generated by the objective viewpoint video generator 202, and an objective viewpoint actually sensed video input from the camera 103.

[0047] Generation of the subjective viewpoint video will be explained below.

[0048] The game state manager 201 updates the information that pertains to rendering of the virtual objects 102 as needed, and outputs the updated information to a subjective viewpoint video generator 212. The subjective viewpoint video generator 212 generates videos of the virtual objects 102 (subjective viewpoint virtual video) viewed from the viewpoint position/posture of the HMD107, on the basis of the information that pertains to rendering of the virtual objects 102, which is input from the game state manager 201, and the camera parameters of the HMD 107, which are input from the camera parameter measurement/management unit 204.

[0049] The generated subjective viewpoint virtual video is output to a subjective viewpoint video composition unit 213.

[0050] The subjective viewpoint video composition unit 213 receives from the HMD 107 the subjective viewpoint actually sensed video that the player 101 watches via the HMD 107. The subjective viewpoint video composition unit 213 generates a subjective viewpoint AR video as a composite video of this subjective viewpoint actually sensed video, and the subjective viewpoint virtual videos input from the subjective viewpoint video generator 212, and outputs that subjective viewpoint AR video to the HMD 107. The subjective viewpoint AR video is displayed on the display screen 501 of the HMD 107, and the player 101 plays the AR game while reviewing this subjective viewpoint AR video.

[0051] Generation of an objective viewpoint video will be explained below.

[0052] The game state manager 201 updates the information that pertains to rendering of the virtual objects 102 as needed, and outputs the updated information to the objective viewpoint video generator 202.

[0053] Since generation of the videos of the virtual objects 102 is implemented by the same processes as those in generation of the subjective viewpoint video, a detailed description thereof will be omitted.

[0054] The generated objective viewpoint virtual video is output to the objective viewpoint video composition unit 203.

[0055] The objective viewpoint video composition unit 203 receives an objective viewpoint actually sensed video from the camera 103. The objective viewpoint video composition unit 203 generates an objective viewpoint AR video as a composite video of this objective viewpoint actually sensed video, and the objective viewpoint virtual videos input from the objective viewpoint video generator 202, and outputs the objective viewpoint AR video to the display 106. This objective viewpoint AR video is displayed on the display 106, and the watcher can see the overall view of the AR game by reviewing this objective viewpoint AR video and can recognize the current situation of the AR game.

[0056] The image coordinate values of the vertices of the polygons that build each virtual object 102 viewed from each viewpoint (HMD 107 or camera 103) can be computed using the coordinate conversion matrix Ml or M2 from the object coordinate system into the image coordinate system. The generation process of such coordinate conversion matrix will be explained below using the block diagram shown in Fig. 3.

[0057] A coordinate conversion matrix Mm from the object coordinate system into a world coordinate system is computed on the basis of the information of the position/posture of each virtual object 102. Also, coordinate conversion matrices Mcl and Mc2 from the world coor-

program code, an objective viewpoint AR video can be presented to a third party other than the player 101 in the AR game using the video see-through HMD 107.

[Second Embodiment]

[0076] In the first embodiment, the HMD 107 is of video see-through type. However, if the HMD 107 is of optical see-through type, the player 101 can still play the AR game.

[0077] Fig. 13 shows an optical see-through HMD 1301. Note that Fig. 13 schematically illustrates the HMD 1301, and the present invention is not limited to the size and shape shown in Fig. 13.

[0078] Reference numeral 1301 denotes an optical see-through HMD; and 1302, the eye of the player 101.

[0079] On the display screen 501, only videos of the virtual objects 102 (subjective viewpoint virtual videos) are displayed. On the other hand, a video of a real space is seen behind the display screen 501 when viewed from the position of the eye 1302. Hence, the player can review videos of the virtual objects 102 and the real space seen behind the display screen 501 when viewed from the position of the eye 1302 to overlap each other by observing the display screen 501.

[0080] Fig. 14 is a block diagram showing the flow of processes of this embodiment.

[0081] A video output from the AR game apparatus 104 to the HMD 1301 is a subjective viewpoint virtual video alone, as described above. Hence, the HMD 1301 and subjective viewpoint video generator 212 are electrically connected via a cable, and a subjective viewpoint virtual video which is generated by the subjective viewpoint video generator 212 on the basis of the position and posture of the HMD 1301 is sent from the subjective viewpoint video generator 212 to the HMD 1301. Note that this embodiment has no subjective viewpoint video composition unit 213 in the first embodiment.

[0082] Also, the method of generating an objective viewpoint AR video is the same as that which has been explained in the first embodiment.

[0083] The internal block diagram of the AR game apparatus 104 in this embodiment is substantially the same as that shown in Fig. 7, except that the objective viewpoint video composition unit 213 is removed from the arrangement shown in Fig. 7.

[0084] In the flow chart of this embodiment, steps S804, S805, and S806 in Fig. 8 are rewritten as follows. More specifically, upon generating a subjective viewpoint AR video (only videos of the virtual objects 102 based on the position and posture of the HMD 1301 in this embodiment) to be displayed on the HMD 1301, steps S804 and S805 are skipped. That is, in step S804 the objective viewpoint video composition unit 203 receives an actually sensed video sensed by the camera 103. In step S805, the objective viewpoint video composition unit 203 generates an objective viewpoint AR video. In step S806, the objective viewpoint video composition unit 203 outputs the objective viewpoint AR video to the display 106, and the subjective viewpoint video generator 212 outputs a subjective viewpoint virtual video to the HMD 1301.

[0085] The flow chart obtained by modifying the contents of Fig. 8 as described above is that in this embodiment, and this embodiment is controlled by a program code according to this modified flow chart.

[0086] With the aforementioned arrangement of the apparatus, augmented reality presentation method, and program code, an objective viewpoint AR video can be presented to a third party other than the player 101 in the AR game using the optical see-through HMD 1301.

[Third Embodiment]

[0087] In the first and second embodiments, the camera parameters of the camera 103 are fixed. That is, an objective viewpoint AR video is generated based on the camera parameters of the camera 103 which is fixed in position. The camera parameter data of the camera 103 are stored as permanent values in the RAM 703 of the AR game apparatus 104.

[0088] A case will be examined below wherein the viewpoint position, posture, and zooming ratio of the camera 103 are changed in real time to those that the player or a third party other than the player 101 (watcher or operator) wants. That is, a case will be examined below wherein the camera parameters of the camera 103 are changed in real time. Note that this embodiment uses a video see-through HMD as in the first embodiment. However, the HMD that can be used in this embodiment is not limited to the video see-through type, but an optical see-through HMD may be used, as can be seen from the description of the second embodiment and this embodiment.

[0089] When the position, posture, and zooming ratio of the camera 103 are to be changed in real time, a measurement means as a means for measuring the position, posture, and zooming ratio of the camera 103 must be added to the first embodiment.

[0090] Fig. 4 is a block diagram showing the flow of processes in this embodiment. The flow of processes in this embodiment will be described below using Fig. 4.

[0091] Like in the first embodiment, in this embodiment the camera parameter measurement/management unit 204 measures and manages the camera parameters of the HMD 107, and holds some internal parameters of the camera 103 as known information. Unlike in the first embodiment, in this embodiment the camera parameter measurement/management unit 204 controls a sensor (not shown) attached to the camera 103 to measure the position, posture, and zooming ratio of the camera 103.

[0092] When the player 101 has changed the position, posture, and zooming ratio of the camera 103 via an interface (not shown), the camera parameter measurement/management unit 204 measures the position, pos-

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augmented reality presentation method, and program code can be applied. In this case, such application can be implemented by connecting the camera system of this embodiment to the AR game apparatus 104 in place of the camera 103 in the third embodiment.

[0110] With the aforementioned arrangement of the apparatus, augmented reality presentation method, and program code, a plurality of objective viewpoint AR videos sensed by a plurality of cameras can be displayed on the display 106.

[Fifth Embodiment]

[0111] In the first to fourth embodiments, an objective viewpoint AR video is presented to a third party other than the player via the display 106 by outputting it to the display 106. Alternatively, the objective viewpoint AR video may be presented to the player 101. That is, a display area 601 shown in Fig. 6 is assured on the display screen 501 of the HMD (which can be of either video or optical see-through type) that the player 101 wears, and the objective viewpoint AR video is displayed there. In Fig. 6, a video displayed on this display screen 501 will be referred to as an augmented video hereinafter.

[0112] In order to generate this augmented video, a program code for setting the display area 601 on the display screen 501, and writing an objective viewpoint AR video on that display area 601 is stored in the RAM 703 of the AR game apparatus 104 in addition to the program code according to the flow chart shown in Fig. 8. As a result, by executing this program code, the augmented video can be displayed on the display screen 501.

[0113] Fig. 11 is a flow chart of the program code for writing the objective viewpoint AR video on the display area 601 mentioned above.

[0114] It is checked in step S1101 if the display area 601 is assured. Selection as to whether or not the display area 601 is assured can be implemented by providing this selection switch to an operation device (not shown) used when the player 101 plays the AR game. Or such selection can be implemented by inputting a command indicating whether or not the display area 601 is assured from the console 705.

[0115] In step S1102, the display position of the display area 601 is input. The display position is input from the console 705. Alternatively, the player 101 may input the display position using the aforementioned operation device.

[0116] In step S1103, the size of the display area 601 is input. The size is input from the console 705. Alternatively, the player 101 may input the size using the aforementioned operation device.

[0117] In step S1104, the display area 601, the setups of which have been determined in steps S1102 and S1103, is assured on the display screen 501.

[0118] In step S1105, the objective viewpoint AR video generated by the objective viewpoint video composition unit 203 is rendered on the display area 601. As a consequence, the augmented video can be generated.

[0119] Note that this augmented video may be output to the display 106.

[0120] Selection of whether the display area 601 is set and the display position and size of the display area 601 may be automatically set/changed not by the player but in accordance with the progress of the game. In this case, the game state manager 201 determines these parameters.

[0121] The display area 601 may be the entire area of the display screen 501.

[0122] With the aforementioned arrangement of the apparatus, augmented reality presentation method, and program code, both the subjective and objective viewpoint AR videos can be presented to the player.

[Sixth Embodiment]

[0123] A plurality of players 101 may join the AR game. In this case, subjective viewpoint AR videos from individual subjective viewpoints must be provided to the individual players. Fig. 15 shows the internal arrangement of the AR game apparatus for providing subjective viewpoint AR videos from the players' subjective viewpoints to the individual players. Note that the camera 103 is fixed in position, and the processes that pertain to the camera 103 and display are the same as those in the first embodiment.

[0124] Fig. 15 shows the internal arrangement for three players. Hence, the AR game apparatus 104 comprises HMDs 107A, 107B, and 107C, subjective viewpoint video composition units 213A, 213B, and 213C, and subjective viewpoint video generators 212A, 212B, and 212C in correspondence with three players a, b, and c. Three players a, b, and c respectively wear the HMDs 107A, 107B, and 107C. This embodiment uses a video see-through HMD, but an optical see-through HMD may be used. In this case, the subjective viewpoint video composition units for the three HMDs can be omitted.

[0125] When the AR game starts, the HMDs, subjective viewpoint video generators, and subjective viewpoint video composition units execute the same processes as those described in the first embodiment, and subjective viewpoint AR videos generated for the individual players are output to the HMDs 107A, 107B, and 107C that the players wear.

[0126] Note that the aforementioned arrangement of the apparatus and augmented reality presentation method are not limited to three players, as is obvious from the above description.

[0127] With the aforementioned arrangement of the apparatus and augmented reality presentation method, subjective viewpoint AR videos can be provided to a plurality of players.

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viewpoint positions, objective viewpoint AR videos viewed from the same viewpoint at different times, or subjective viewpoint AR videos of the respective players on one paper sheet. In this case, the print controller 301 selects a viewpoint in accordance with a command input from the console 705 and stores the AR video viewed from the selected viewpoint. The print controller 301 determines a layout for printing a plurality of stored images on one paper sheet in accordance with a command input from the console 705 and outputs them to the printer 302.

[0142] The command may be automatically input to the print controller 301 in accordance with the progress of a game without using the console 705. In this case, a game state manager 201 transmits a command to the print controller 301. The command may be transmitted at a fixed timing preset in accordance with the progress of the game or a dynamic timing corresponding to the progress of the game such that the distance between the player and a virtual object 102 becomes a predetermined interval or less.

[0143] The camera 103 (or camera 901) can be located at an arbitrary position. The third party can easily grasp the state of the game when the camera is located at a position where the entire AR space can be observed from the bird-view position or a position where the upper half image (so-called bust shot) of the player can be sensed from the front.

[0144] As described above, according to the present invention, a video of the AR game viewed from the subjective viewpoint of the player can be generated, and, simultaneously, a video of the AR game viewed from an objective viewpoint to see the overall view of the game field or a video of the AR game viewed from a viewpoint the watcher wants can be generated.

[0145] As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

[0146] A game state manager (201) manages the state of an AR game (information that pertains to rendering of each virtual object (102), the score of a player (101), the AR game round count, and the like). An objective viewpoint video generator (202) generates a video of each virtual object (102) viewed from a camera (103). An objective viewpoint video composition unit (203) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to a display (106). A subjective viewpoint video generator (212) generates a video of the virtual object (102) viewed from an HMD (107). A subjective viewpoint video composition unit (213) generates a composite video of the video of the virtual object (102) and an actually sensed video, and outputs it to the HMD (107).

Claims

1. An augmented reality presentation apparatus for superimposing a virtual object in a real space, characterized by comprising:

   augmented reality presentation means for superimposing the virtual object viewed from a player's viewpoint position in the real space viewed from said player's viewpoint position;
   the first video sensing means for sensing a video of the real space viewed from a first viewpoint position which differ from said player's viewpoint position;
   the first video generation means for generating a video of the virtual object viewed from said first viewpoint position;
   and
   the first video composition means for compositing an augmented reality video viewed from said first viewpoint position on the basis of said videos of the real space and the virtual object viewed from said first viewpoint position.

2. The apparatus according to claim 1, characterized in that said augmented reality presentation means further comprises:

   the second video sensing means for sensing a video of the real space viewed from said player's viewpoint position;
   the second video generation means for generating a video of the virtual object viewed from said player's viewpoint position;
   the second video composition means for compositing an augmented reality video viewed from said player's viewpoint position on the basis of said videos of the real space and the virtual object viewed from said player's viewpoint position;
   and
   the display means for displaying to the player the augmented reality video viewed from said player's viewpoint position.

3. The apparatus according to claim 1, characterized in that said augmented reality presentation means further comprises:

   the second video generation means for generating a video of the virtual object viewed from said player's viewpoint position;
   and
   the display means for displaying to the player the video of the virtual object viewed from said player's viewpoint position on a display surface through which the player can visually see the real space.

through which the player can visually see the real space.

13. The method according to any one of claim 10 to 12, characterized by further comprising the information generation step of generating information that pertains to rendering of the virtual object,
and
in that in said first video generation step and said second video generation step, videos of the virtual object are generated using the information that pertains to rendering of the virtual object.

14. The method according to claim 13, characterized in that said information generation step includes the step of generating information of an outer appearance of the virtual object and information of a position/posture of the virtual object as the information that pertains to rendering of the virtual object.

15. The method according to claim 10 or 13, characterized in that parameters of means for sensing said first viewpoint video are known, and
said first video generation step includes the step of generating the video of the virtual object viewed from said first viewpoint position in accordance with the known parameters.

16. The method according to claim 10 or 13,
characterized
in that some of parameters of means for sensing a video viewed from said first viewpoint position are variable,

said method further comprises the measurement step of measuring changes of the parameters,
and
said first video generation step includes the step of generating the video of the virtual object viewed from said first viewpoint position in accordance with the parameters measured in the measurement step.

17. The method according to claim 16, characterized in that the parameters of the means for sensing a video viewed from said first viewpoint position measured in the measurement step include at least one of a viewpoint position/posture, and zoom ratio.

18. The method according to claim 10, characterized in that when a plurality of means for sensing a video viewed from said first viewpoint position are present,

said method further comprises the selection step of receiving a plurality of videos of the real space viewed from a first viewpoint position from the plurality of means for sensing a video viewed from said first viewpoint position, and outputting the video of the real space viewed from a first viewpoint position input from one selected means for sensing a video of said first viewpoint position to means for compositing a first viewpoint video, and
said first video composition step includes the step of generating a video of the virtual object viewed from said first viewpoint position using parameters of the means for sensing a video viewed from a first viewpoint position selected in the selection step.

19. A storage medium storing a program code for superimposing a virtual object in a real space when said program code is loaded by a computer, characterized by comprising:

a program code of the augmented reality presentation step of superimposing the virtual object viewed from a player's viewpoint position in the real space viewed from said player' viewpoint position;
a program code of the first video sensing step of sensing a video of the real space viewed from a first viewpoint position which differ from said player's viewpoint position;
a program code of the first video generation step of generating a video of the virtual object viewed from said first viewpoint position;
and
a program code of the first video composition step of compositing an augmented reality video viewed from said first viewpoint position on the basis of said videos of-the real space and the virtual object viewed from said first viewpoint position.

20. The medium according to claim 19, characterized in that the program code of the augmented reality presentation step further comprises:

a program code of the second video sensing step of sensing a video of the real space viewed from said player's viewpoint position;
a program code of the second video generation step of generating a video of the virtual object viewed from said player's viewpoint position;
a program code of the second video composition step of compositing an augmented reality video viewed from said player's viewpoint position on the basis of said videos of the real space and the virtual object viewed from said player's viewpoint position;
and
a program code of the display step of displaying to the player the augmented reality video

FIG. 1

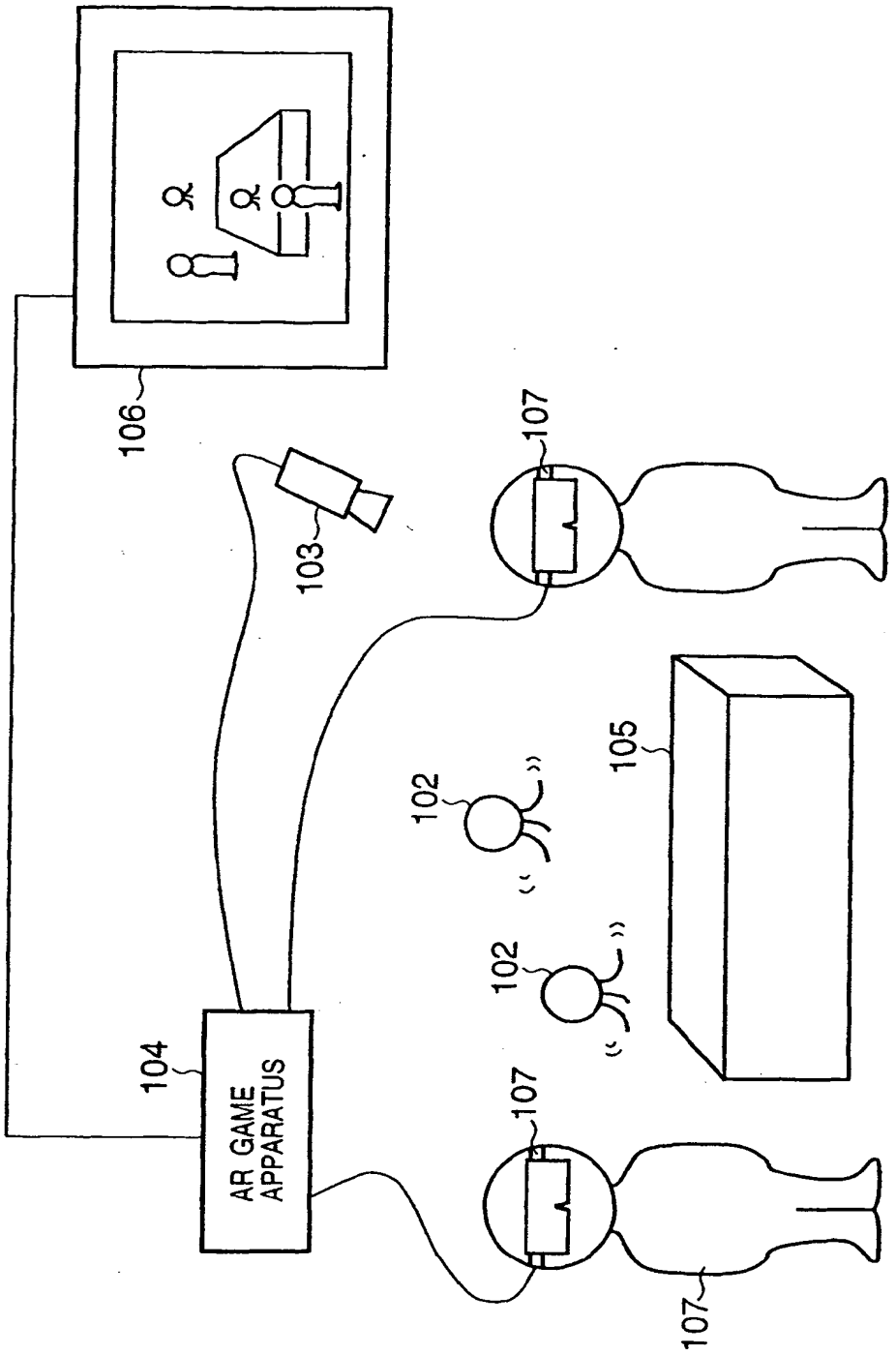

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FIG. 3

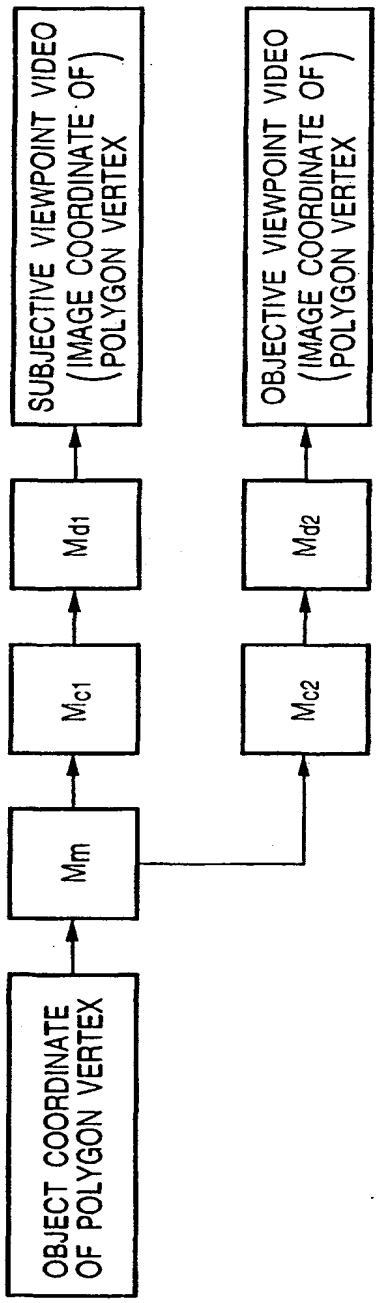

OBJECT COORDINATE OF POLYGON VERTEX
Mm
Mc1
Md1
SUBJECTIVE VIEWPOINT VIDEO (IMAGE COORDINATE OF POLYGON VERTEX
Mc2
Md2
OBJECTIVE VIEWPOINT VIDEO (IMAGE COORDINATE OF POLYGON VERTEX

FIG. 5

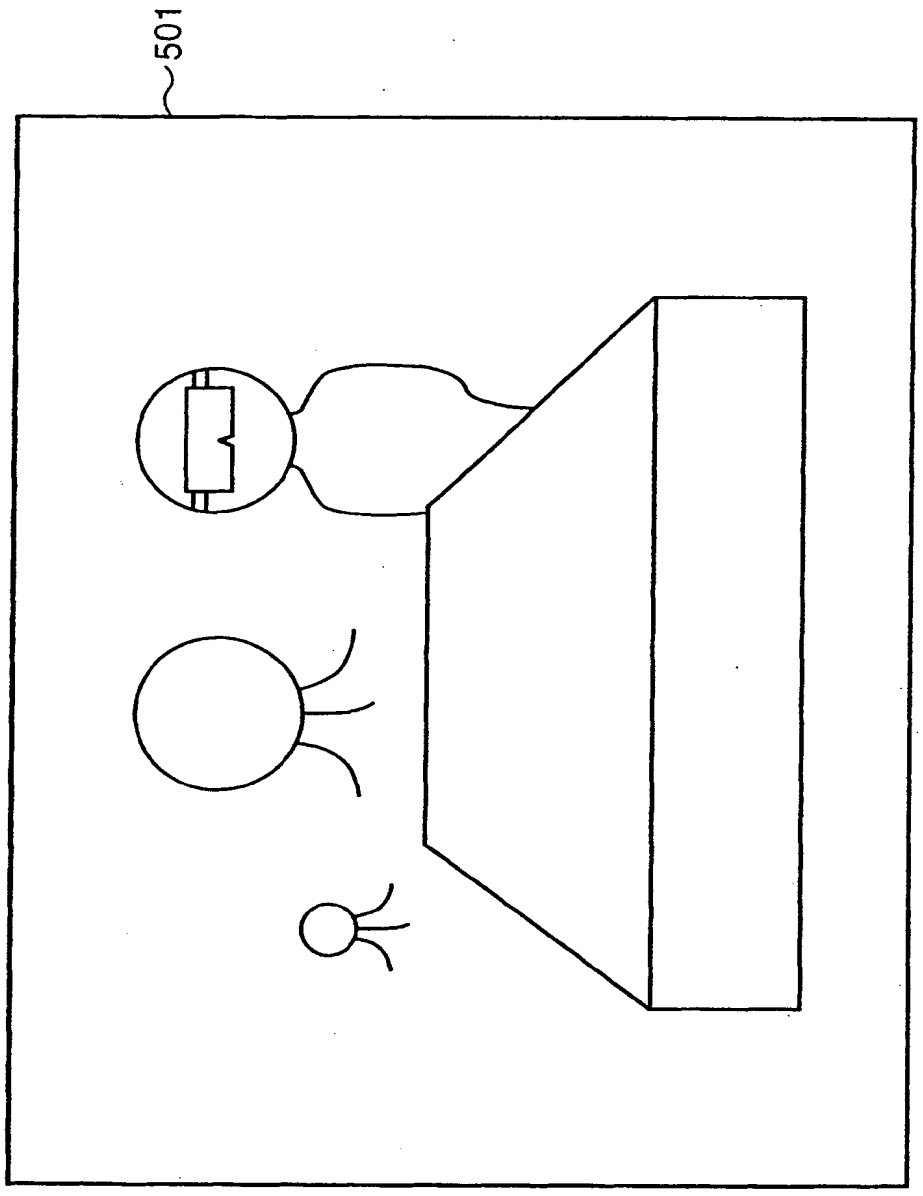


FIG. 7

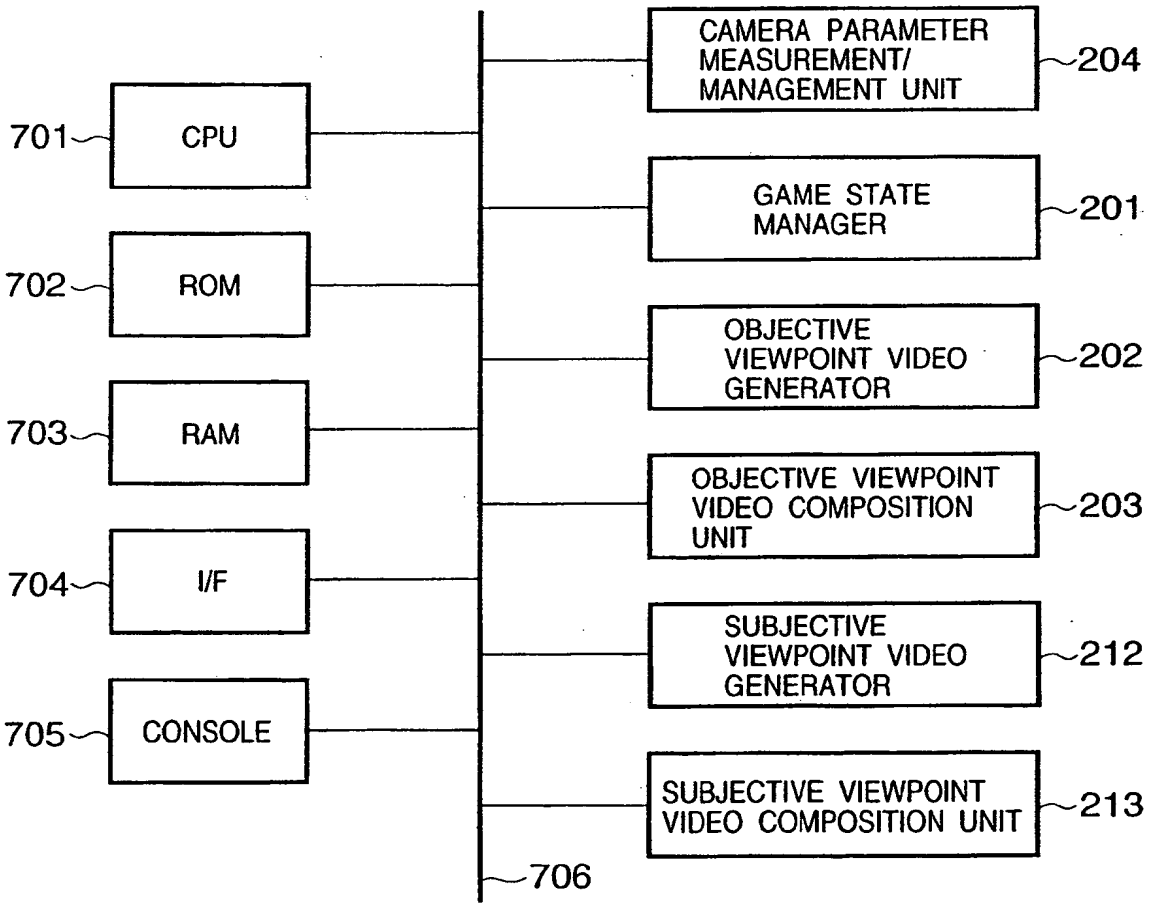

CAMERA PARAMETER MEASUREMENT/ MANAGEMENT UNIT
204
701
CPU
GAME STATE MANAGER
201
702
ROM
OBJECTIVE VIEWPOINT VIDEO GENERATOR
202
703
RAM
OBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT
203
704
I/F
SUBJECTIVE VIEWPOINT VIDEO GENERATOR
212
705
CONSOLE
SUBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT
213
706

FIG. 9

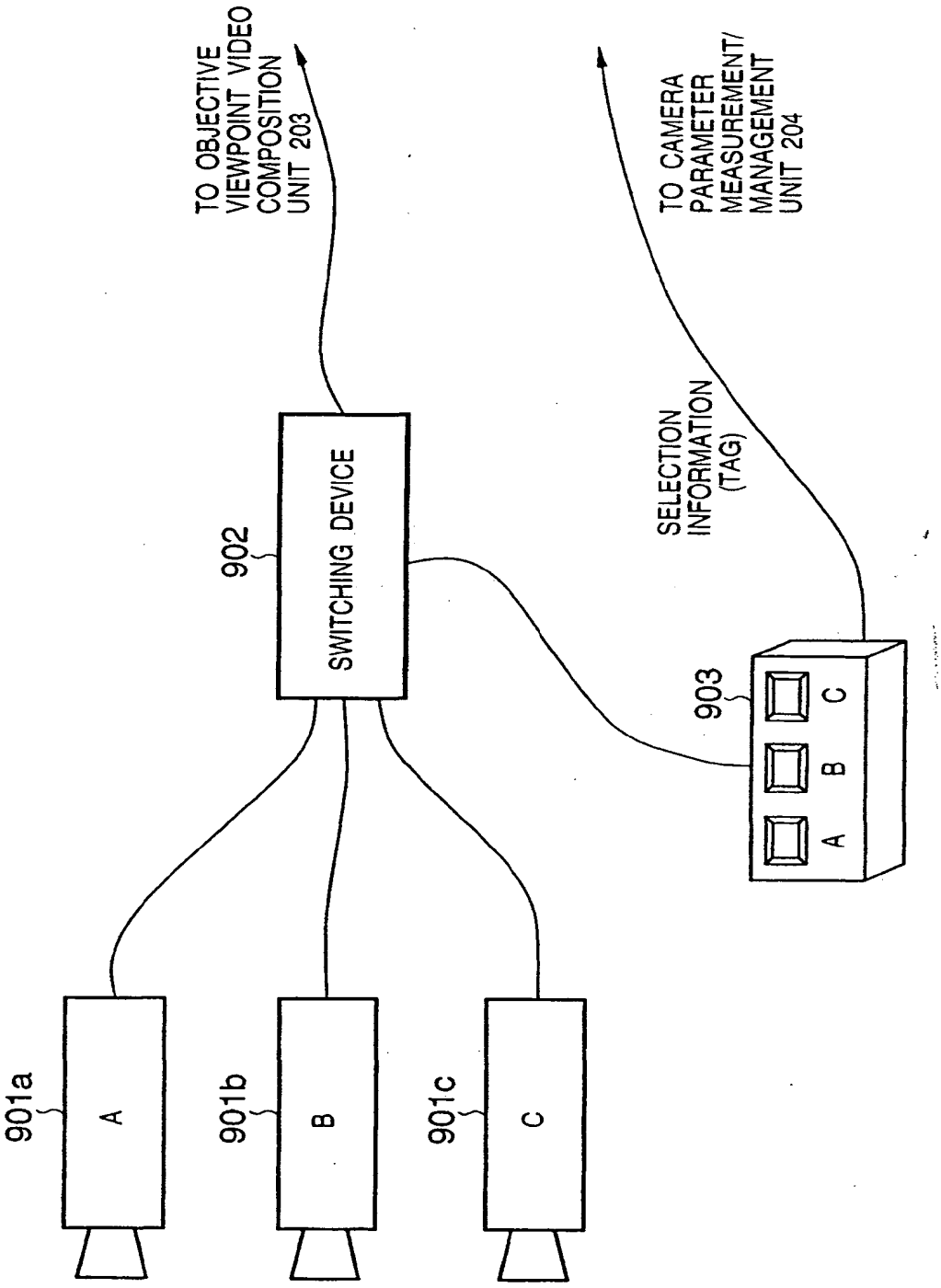

TO OBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT 203
TO CAMERA PARAMETER MEASUREMENT/ MANAGEMENT UNIT 204
SELECTION INFORMATION (TAG)
902
SWITCHING DEVICE
903
A
B
C
901a
A
901b
B
901c
C

FIG. 11

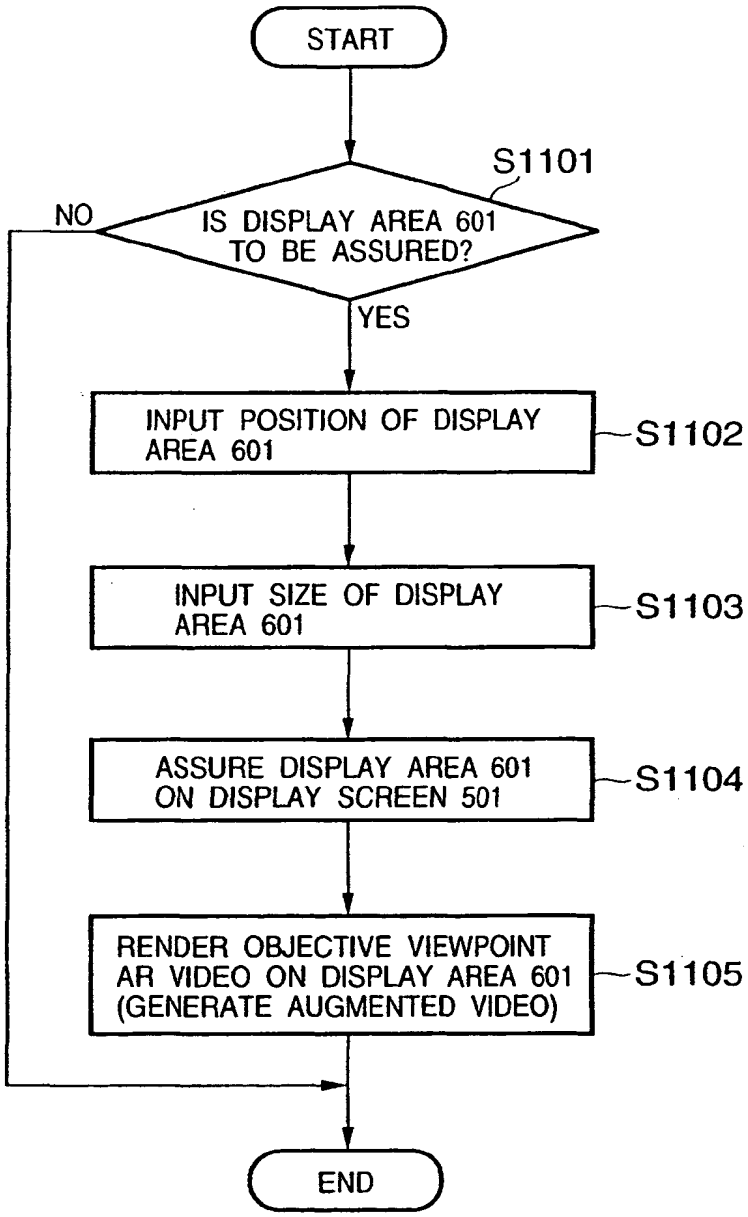

START
S1101
IS DISPLAY AREA 601 TO BE ASSURED?
NO
YES
INPUT POSITION OF DISPLAY AREA 601
S1102
INPUT SIZE OF DISPLAY AREA 601
S1103
ASSURE DISPLAY AREA 601 ON DISPLAY SCREEN 501
S1104
RENDER OBJECTIVE VIEWPOINT AR VIDEO ON DISPLAY AREA 601 (GENERATE AUGMENTED VIDEO)
S1105
END

FIG. 13

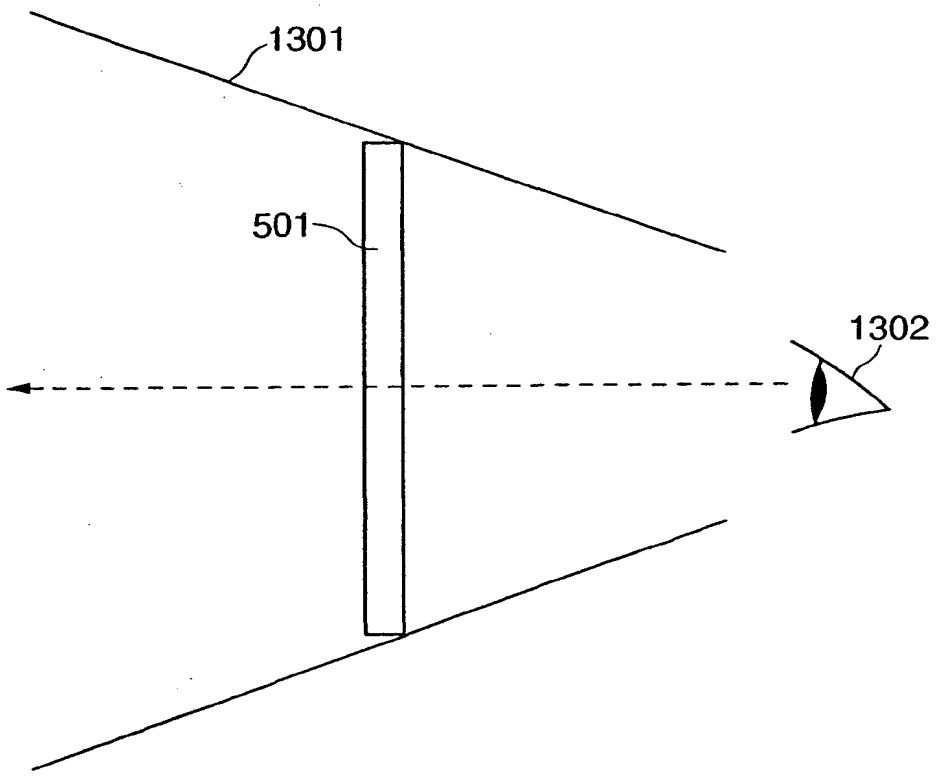


FIG. 15

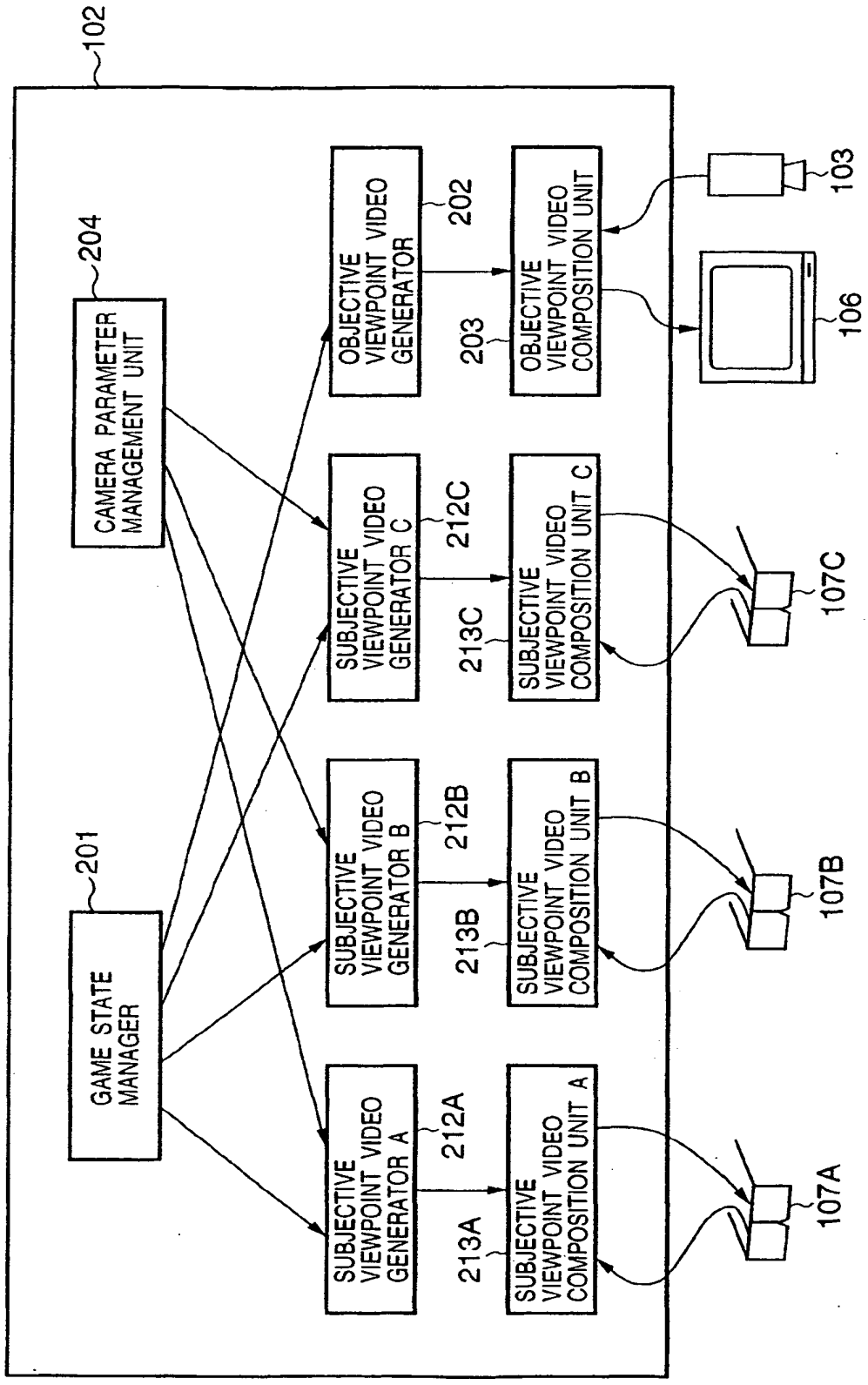
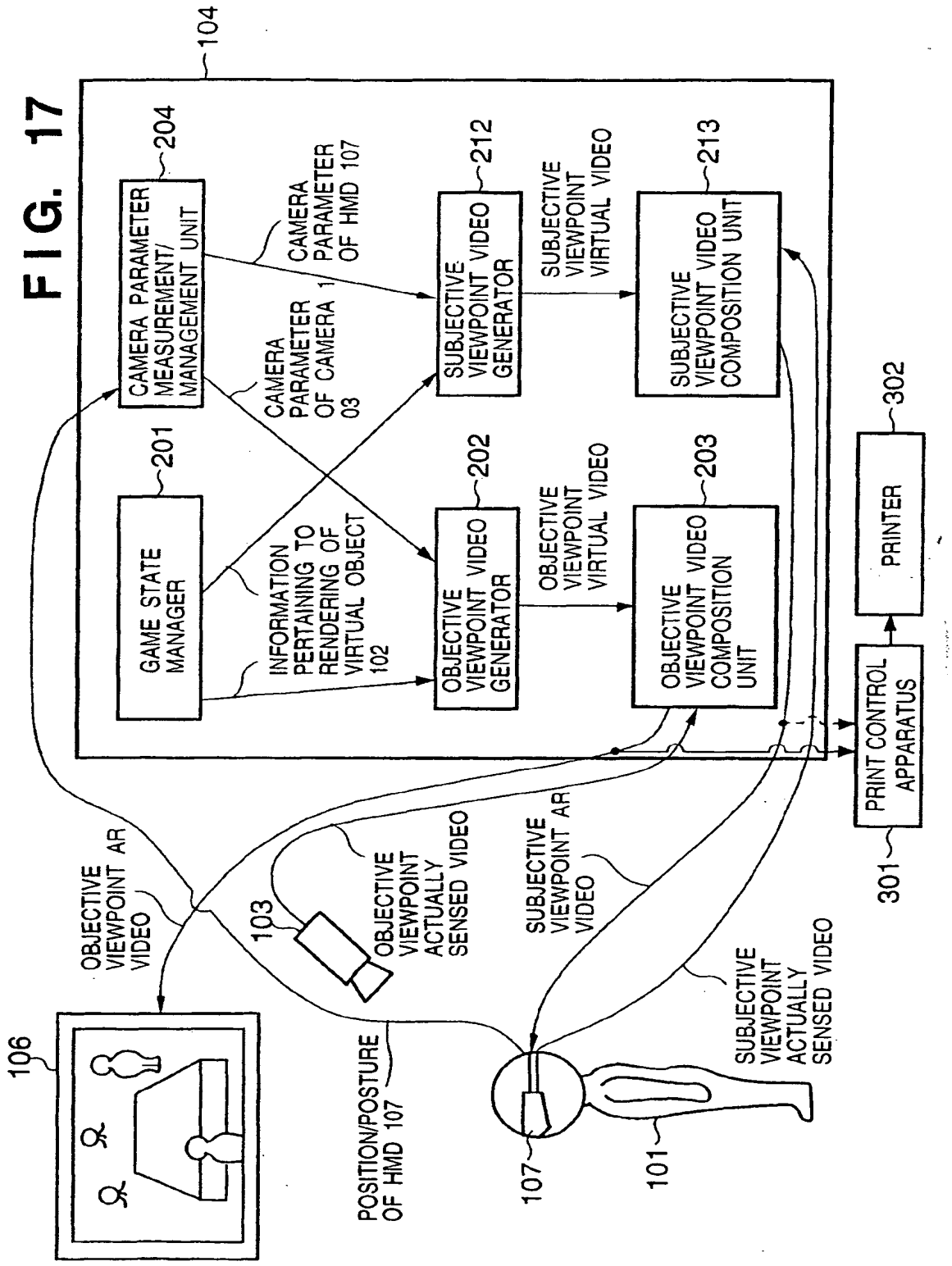

102
204
CAMERA PARAMETER MANAGEMENT UNIT
201
GAME STATE MANAGER
OBJECTIVE VIEWPOINT VIDEO GENERATOR
202
203
OBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT
SUBJECTIVE VIEWPOINT VIDEO GENERATOR C
212C
213C
SUBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT C
SUBJECTIVE VIEWPOINT VIDEO GENERATOR B
212B
213B
SUBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT B
SUBJECTIVE VIEWPOINT VIDEO GENERATOR A
212A
213A
SUBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT A
103
106
107C
107B
107A

FIG. 17


104
CAMERA PARAMETER MEASUREMENT/ MANAGEMENT UNIT
204
CAMERA PARAMETER OF HMD 107
CAMERA PARAMETER OF CAMERA 1 03
SUBJECTIVE VIEWPOINT VIDEO GENERATOR
212
SUBJECTIVE VIEWPOINT VIRTUAL VIDEO
SUBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT
213
GAME STATE MANAGER
201
INFORMATION PERTAINING TO RENDERING OF VIRTUAL OBJECT 102
OBJECTIVE VIEWPOINT VIDEO GENERATOR
202
OBJECTIVE VIEWPOINT VIRTUAL VIDEO
OBJECTIVE VIEWPOINT VIDEO COMPOSITION UNIT
203
PRINTER
302
PRINT CONTROL APPARATUS
301
OBJECTIVE VIEWPOINT AR VIDEO
OBJECTIVE VIEWPOINT ACTUALLY SENSED VIDEO
103
SUBJECTIVE VIEWPOINT AR VIDEO
SUBJECTIVE VIEWPOINT ACTUALLY SENSED VIDEO
106
POSITION/POSTURE OF HMD 107
107
101